Technology in Different Worlds

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Insight into the relation between technology and society can be obtained by imagining that the world is organized differently and then determining how technology would be different. This approach is illustrated by discussion of three alternative worlds: one in which defense is carried out by nonviolent methods, one in which there is no intellectual property, and one in which workers control decisions about their work.

If the world were organized in a way different from the way it is now, then the sort of technology would also be different, at least to some degree. By proposing some different ways of organizing the world and deciding how technologies would be different, it is possible to obtain insights into the shaping of actually existing technologies.

To illustrate this sort of analysis, three alternative worlds are proposed:

1. a world in which military defense is replaced by defense through nonviolent community resistance,
2. a world in which there is no intellectual property, and
3. a world in which workers (rather than employers) collectively control all major decisions about their work.

Each of these alternative worlds would lead to differences in artifacts and technological systems, for example, in weapons, communication, drugs, and factories. By comparing technology in such alternative worlds with present-day technology, insight is given into the dominant forces shaping technology, into ignored or suppressed technological options, and into the way that technology shapes social options.

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Technology and Society

In the study of interactions between technology and society, there are several possible ways of thinking, each of which has advantages and disadvantages. For the sake of simplicity, let us examine four models. The first looks at the influence that technology has on society (see Figure 1). This approach can be called the impact of technology on society. If, in Model 1, technology is taken to be autonomous, namely to develop solely according to its own internal logic, then the result is technological determinism, something that all scholars of technology conscientiously try to avoid (Smith & Marx, 1994).

A second model reverses the focus and looks instead at the influence that society has on technology (see Figure 2). This approach is commonly called the social shaping of technology (MacKenzie & Wajcman, 1985). It also captures the perspective in which technology is seen as the embodiment of social relations. If society is taken to be autonomous and technology is taken to be entirely malleable, then this model becomes social determinism.

Each of these models captures only part of the technology-society dynamic, so it is natural to include both processes (see Figure 3). This approach can be called the coevolution of society and technology.

All three of these approaches conceptualize society and technology as two different realms. Actor-network theorists think that this conceptualization may hide as much as it reveals, and they prefer to incorporate humans, artifacts, and other entities under the general term *actant* (Latour, 1987) (see Figure 4).

Let us turn now to the way each of these models is used to study technology, society, or both. In Model 1, it is common to compare the impacts of different technologies. For example, introduction of one particular technology, called technology-1, leads to certain consequences for society, which can be called society-1. If that technology is not introduced, or if

Figure 1. Model 1

Figure 2. Model 2

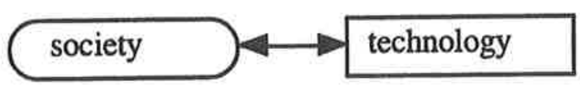

Figure 3. Model 3

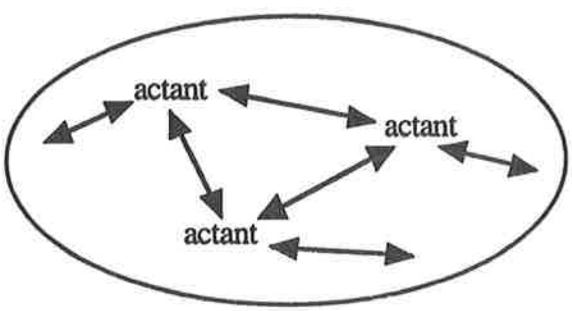

Figure 4. Model 4

some other technology is introduced instead, there are different consequences (see Figure 5). This approach is used by peace movements. If technology-1 is nuclear weapons, then society-1 may include mass deaths, environmental devastation, international tensions, and so forth. If technology-2 is no nuclear weapons, society-2 has fewer such consequences. On the basis of such analyses, social activists have campaigned against nuclear weapons, biological weapons, land mines, nuclear power, supersonic transports, and many other technologies. They have also campaigned in favor of bicycles, community radio, and renewable energy. Of course, the same sort of analysis can be used to reach different conclusions. Proponents of nuclear weapons argue that society-1 has a reduced risk of war and dictatorship compared to society-2.

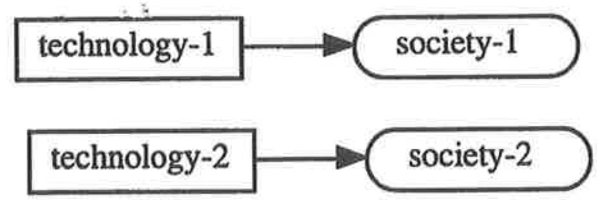

Figure 5.

Although Model 1 is commonly used for practical thinking, scholars of technology in recent years have given much more attention to Model 2. Studies look at possible technologies—often variants of the same generic technology, such as the bicycle, rifle, or refrigerator—and try to see how social factors influence choices (see Figure 6). This approach is useful for showing that things could have been different. However, this is not news to social movements campaigning around technology. Activists must believe that things could be different, otherwise why would they bother campaigning?

Each of the standard models has advantages and disadvantages. However, my aim here is not to examine or criticize the usual models but, rather, to discuss an approach that has received relatively little attention.

The basic idea is to propose possible societies and then to look at the technologies they would develop. This is a variant on Model 2 (see Figure 7). This approach can best be explained by illustration. In the next three sections, three case studies are examined: society with and without military defense, society with and without intellectual property, and society with and without bureaucracy at work. Each of these areas is potentially vast, and only outlines can be given here.

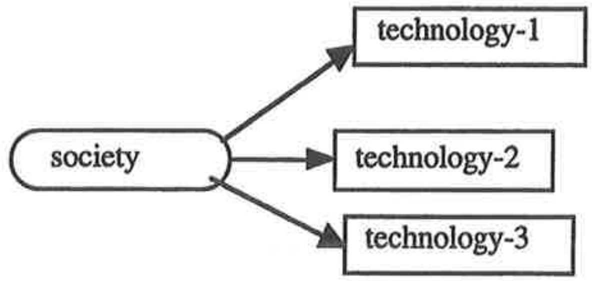

Figure 6.

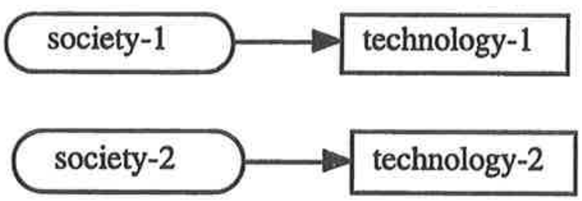

Figure 7.

After discussing the case studies, I will mention some further issues that need to be addressed and suggest some implications of the approach.

Shaping of Technology by Military Defense and by Social Defense

A considerable proportion of the world's scientists and engineers are engaged in military research and development (R&D), which is an enormous enterprise financially and organizationally. This has a considerable effect on the technologies that exist in the world (Clarke, 1971; Mendelsohn, Smith, & Weingart, 1988; Salomon, 1990; van Creveld, 1989). At the most obvious level, there are weapons and weapons systems, including rifles, grenades, tanks, radar, airplanes, submarines, missiles, and bombs. Few of these would exist at all, or not in their current form, without military spending.

At one remove, there are civilian technologies that are strongly influenced by military priorities, such as nuclear power and space programs. Research priorities are also influenced by military spending and applications, for example, in the fields of nuclear physics, microelectronics, oceanography, and psychology. At another level of influence, it can be argued that technological systems in areas such as energy and agriculture may partially reflect military priorities. Fuels such as oil and coal are found in geographically distinct areas. Building an energy system on such fuels may be perceived as more viable if there are military capacities to control sources of fuel.

Finally, military defense is associated with other social structures, including the state, bureaucracy, and neocolonialism. For example, the state relies on military power as its ultimate protection from external enemies and from internal insurrection, while the military is funded from revenues collected by the state. Through this symbiosis of the military and the state, the military has an indirect influence on many state-run or state-regulated technological systems, from roads to banking.

Let us now consider an alternative to military defense, namely, defense based on nonviolent community resistance to aggression using methods such as strikes, boycotts, rallies, and sit-ins. There is a long history of nonviolent struggle throughout the world, but it is only in the 1900s that nonviolent action has been consciously conceived as a method of struggle, notably by Gandhi. Since the 1950s, a number of researchers have proposed that nonviolent methods could replace military defense. This alternative is called various names, including social defense, civilian-based defense, nonviolent defense, and defense by civil resistance (Boserup & Mack, 1974; Burrowes, 1996; Geeraerts, 1977; Martin, 1993; Niezing, 1987; Randle, 1994).

The potential of this form of struggle is suggested by some historical cases, including the collapse of the Algerian Generals' revolt in 1961, the Czechoslovak resistance to the Soviet invasion of 1968, the toppling of the Marcos dictatorship in the Philippines in 1986 by "people power," the collapse of Eastern European governments in 1989, and the thwarting of the Soviet coup in 1991. None of these events is an illustration of social defense, however, because they were largely spontaneous uses of nonviolent action. Military defense, in contrast, is carefully prepared, with planning, training of soldiers, and—not least—acquisition of suitable technology.

Imagine that the money and effort currently devoted to military technologies instead were devoted to systems to support social defense. How would this affect technology? (See Martin, 1997.)

Because social defense is based on nonviolent methods, there is no need for weapons systems of any kind. Analysts of social defense agree that social and psychological factors are crucial to its success. Therefore, conversion to social defense R&D would lead to a massive reorientation from natural sciences and engineering to social sciences. Even in the social sciences, however, the orientation would change. Instead of seeking to determine how best to train soldiers to obey orders and to kill in combat, the goal would be to learn how to build skills in collective development of nonviolent strategy, commitment in the face of repression, and skills in persuading opponents.

Although sociological and psychological research is of vital importance to social defense, the natural sciences and engineering do have roles to play. The most important area is communication. Centralized communication systems such as television are obvious targets for an aggressor. Nonviolent resistance is aided by decentralized network communication systems such as the post, telephone, short-wave radio, fax, and e-mail. There are many puzzles that need investigation, such as how best to design e-mail systems so that an aggressor cannot easily shut them down or exercise surveillance.

Also important for social defense is the capacity for a community to survive attacks on vital systems, including energy, agriculture, water supply, health, and transport. Communities with decentralized and self-reliant systems for food, water, energy, and other necessities are far harder for an aggressor to subdue.

Reorienting technology from military priorities to social defense priorities would also change methods for R&D. Because social defense is based on widespread participation, useful technologies would need to be tried out by a cross-section of the population. Whereas military weapons are developed in-house and used by military personnel, effective social defense R&D would need to be more participatory.

From this preliminary assessment, it is apparent that the mode of defense in a society plays a major role in shaping its technology. If military priorities were replaced by social-defense priorities, there would be a massive shift from natural sciences and engineering to social sciences, a shift in the key research questions asked in all fields, and a change to a more participatory process for technological development.

Although military technology has received a vast amount of funding and has manifold consequences, this area has received relatively little attention from technology-studies scholars. Those who have investigated the area have concentrated on military technologies that exist, including processes of social shaping and social impact. By looking instead at the implications for technology of a different mode of defense—social defense—some of the wider ramifications of the military shaping of technology are revealed.

Shaping of Technology by Intellectual Property and Common Use

Intellectual property—patents, copyrights, trademarks, and trade secrets—is ostensibly designed to foster the creation of ideas by granting monopolies over their use. Although the main effect of intellectual property may seem to be on ideas, there are also technological impacts. Government protection of claims to intellectual property fosters investment in proprietary drugs, genetically engineered organisms, proprietary software, and artifacts embodying trademarks. Because governments allow intellectual property to be bought and sold and allow corporations to be owners, intellectual property is an aspect of the commodification of knowledge and a reflection and reinforcement of capitalist social relations.

Intellectual property is fundamentally different from physical property, because the author of a poem can still enjoy it no matter how many other people have copies. Intellectual property is perhaps better not described as property at all and instead called *monopoly privilege* (Boyle, 1996; Drahos, 1996; Martin, 1995; Vaver, 1996).

One alternative to intellectual property is common use, analogous to a commons in the case of land. Common use means that there is no owner, neither individual, corporation, nor government. Two systems in which common use generally prevails are language and science. People can use old or new words without much restraint (except for trademarks and copyright restrictions), and both everyday and specialist language develops in a dynamic fashion. Similarly, most scientific ideas are in the public domain and free to be used by others. If copyright applied to scientific formulas, $E = mc^2$ might still be protected. However, there is a lot of secret research, both in government and corporations, and intellectual property rights are increasingly being sought for scientific discoveries.

Intellectual property only dates back one or two centuries, and even today it is quite uneven across the world. Many third world farmers and governments believe that patenting of life forms is simply exploiting their common heritage to benefit first world corporate interests. Intellectual property is neither inevitable nor inherently rational; it is one particular way of ordering relations between power and knowledge.

Imagine that intellectual property was abolished. What would be the implications for technology? Likely consequences would include a decline in corporate development of sophisticated drugs and a rise in small business and community-based testing and marketing of drugs, and a shift from proprietary software to free software (which is already available in large quantities). Local development and adaptation would blossom, because there would be fewer constraints on using and adapting available products. There might be a greater emphasis on service rather than on products. Finally, common use might foster greater cooperation in production of useful products, because "stealing" of ideas would be less of a concern.

Although there is a connection between the rise of the concept of the author and the rise of intellectual property, common use does not mean the end of authorship or an open invitation for plagiarism. Credit for intellectual contributions is largely a separate issue from owning intellectual property rights, and copyright is almost never a successful means of combating plagiarism.

Little of the vast amount of writing about intellectual property questions whether it should exist at all. The social shaping of technology via intellectual property has hardly been studied. One way to examine the issue is to look at alternative schemes for dealing with ideas, of which common use is one. Another is to examine the likely consequences of a much more extensive intellectual property system in which, for example, scientific formulas could be copyrighted.

Shaping of Technology by Bureaucratic Control and Workers' Control

The standard system by which large work organizations are structured is bureaucracy, which is a system of social relationships for organizing work based on hierarchical authority, a detailed division of labor, rules, and standard procedures. Bureaucratic systems are found in government, corporations, trade unions, churches, political parties, and elsewhere, and indeed are so pervasive that alternatives are seen as marginal. In bureaucracies, workers are supervised by bosses. One way to characterize bureaucracy is as a system in which workers are replaceable cogs (Abrahamsson, 1977; Hummel, 1977; Jackall, 1988; Jacoby, 1973; Perrow, 1979).

The bureaucratic mode of work has significant impacts on technologies. The factory system itself can be attributed to a replacement of the locally controlled "putting-out" system, by a system in which employers directly controlled labor power (Marglin, 1974). Therefore, the characteristic technologies of factory production—of which the assembly line is the most well known but is only one example—reflect bureaucratic control. To some extent, the commodity form itself is shaped by bureaucratic production methods. Numerous artifacts reflect the commodity form, from "global products" (of which different components are produced or assembled in different countries) to shopping complexes. More specifically, production technologies may be designed in a way that keeps workers in a subordinate position, as in the case of numerical control (Noble, 1984).

Most R&D is postulated on maintaining bureaucratic control. Workers may resist employer demands by go-slows, sabotage, or organizing to demand different working conditions. Employers, for their part, seek to introduce systems that reduce the capacity of workers to oppose or frustrate employers, for example, by choosing technological systems that are centrally controlled, using surveillance, and introducing management systems to thwart or co-opt worker organization.

Imagine that workers' control replaced bureaucratic control. Workers would collectively decide on what products to produce, how to organize their work, and what technologies to use in doing it. The idea of workers' control (also called workers' self-management) has existed since the rise of workers' movements in the 1800s (Hunnius, Garson, & Case, 1973; Roberts, 1973). It is opposed to both capitalist control and to state socialist control, although worker-controlled enterprises can exist in market-based and socialist systems. Workers' control should be distinguished from industrial democracy, which often refers to consultative and representative practices within a bureaucratic structure. Workers' control is also a far cry from the flat hierarchies that are so widely touted in management literature and that are only a variation on standard bureaucracies.

There are a number of examples of workers' control. Some small enterprises are run in this fashion; often, they are called cooperatives or collectives (Thornley, 1981). In some revolutionary periods, workers' control has prevailed over large sections of industry, such as in Spain after the revolution in 1936 and briefly in Russia during and after the 1917 revolution. The collectives in Spain were crushed after the victory of the fascists, and the soviets in Russia were crushed after the Bolsheviks consolidated power (Guérin, 1970).

How would workers' control affect technology? In general terms, production systems would be designed to engage and foster workers' skills; minimize harm to workers; and, to some extent, produce socially useful goods. In sociotechnical design, technologies are chosen or designed in conjunction with the needs of the workers (Herbst, 1974). Assembly lines would be out, and a variety of systems, appropriate to evolving skills and interests of workers, would be introduced. There is some evidence that self-managed enterprises are likely to be more responsive to human needs than are typical bureaucratic enterprises. The example of the Lucas Aerospace workers' plan—however far short of workers' control—fits this pattern (Wainwright & Elliott, 1982).

If workers' control is broadened to worker-community control, adding in community interests as well as worker interests in the control of production, then the implications may be even more far reaching. There might well be a decrease in the importance of the commodity form, which shapes so many artifacts, and an increase in collective provision, for example, community gardens for food production, community-built housing, public transport, decentralized renewable energy systems, and preventive medicine. This would have effects on the choice of technology in areas of agriculture, construction, transport, energy, and medicine.

R&D under workers' control would almost have to be participatory. It would be under the control of the workers in a general sense and, more specifically, to be of any use to them, it would need to engage them in formulating problems and developing solutions. This would be a huge contrast to normal R&D, which is management driven and whose products commonly are imposed on workers, who then have only the choice of accepting or resisting them.

Aside from studies on sociotechnical design, there has been very little study of the implications for workers' control for technology. Bureaucratic systems play a major role in shaping today's technological systems, yet it is difficult to see the influence because alternatives are not investigated. Studying the implications of workers' control is one way to do this.

Some Issues Not Addressed

This brief introduction to studying technology in different worlds leaves out many issues.

- As well as utopian alternatives, emphasizing peace, cooperation, and participation, it is also possible to imagine dystopias. For example, a world dictatorship might engage in R&D to develop ever more powerful methods of surveillance, torture, and genetic control. Examining dystopian alternatives can be a useful method of exploring the shaping of technology. Some science fiction writers are good at this.
- The criteria for what constitutes a "different world" remain to be specified. Is it enough to postulate a different policy on some current issue, or should the difference be more fundamental? When does a different world become so speculative that it reveals nothing?
- In proposing different worlds, there can be problems of self-consistency, because changing one element in the world will change others. For example, introducing social defense might undermine bureaucracies: If people have the skills and confidence to challenge aggressors nonviolently, they might use those skills against bosses (Martin, Callaghan, & Fox, 1977). Should alternative worlds be conceived self-consistently, or is the exercise useful without this requirement?
- After proposing a different world, the likely consequences for technology can be analyzed. But, how can anyone's ideas about these likely consequences be validated? One way is to look at technologies used or developed in local situations that prefigure or reflect the alternative, such as discrete instances of workers' control. Another is to interview experts about how they would deal with the different situation, for example, to interview communication specialists about choosing, using, and designing communication systems for nonviolent struggle. There inevitably will be disagreements and uncertainties in any such evaluation. How should they be dealt with?

Conclusions

The examination of different worlds and their likely technologies provides a window into the social shaping of technology. It is not the only way to proceed, but it can be useful for certain purposes.

By postulating radically different worlds, it is possible to uncover some of the more far-reaching links between society and technology. For example, contrasting technologies shaped by military and nonviolent priorities reveals effects in artifacts produced, research problems considered important, funding of different scientific fields, and research methods.

By considering technology in different worlds, some insight is provided into the relative importance of technology in different sorts of social change. For example, removing intellectual property would probably have a smaller impact on technology than will introducing workers' control.

Finally, studies of technology in different worlds may reveal insights about how best to intervene to bring about different worlds. Technology is one window into social change. It is not the only one, but it is one worth viewing.

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